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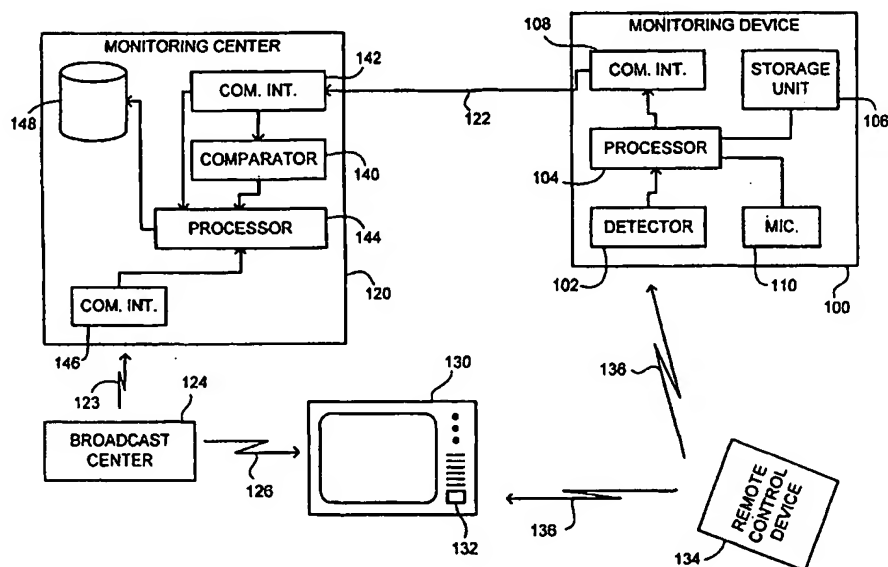
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## (54) Title: MONITORING SYSTEM



## (57) Abstract

Monitoring device (100) including a processor (104), a television remote control unit signal detector (102), connected to the processor, a signal capturing unit (110), connected to the processor and a communication interface (108) connected to the processor, wherein the television remote control unit signal detector (102) provides detected television remote control unit (134) signal to the processor, the signal capturing unit provides detected television signal to the processor, and wherein the processor transmits data related to the detected television signal and the detected television remote control unit signal to a remote monitoring center (120) via the communication interface.

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## MONITORING SYSTEM

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### FIELD OF THE INVENTION

The present invention relates to a method and apparatus for monitoring video streams in general, and to a method and apparatus for monitoring television viewing habits, in particular.

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### BACKGROUND OF THE INVENTION

Television monitoring methods and systems are known in the art. Such systems are used to monitor the habits of television viewers and rate television channels and programs according to their popularity.

Some of these systems employ remote control detectors which receive transmissions produced by a remote control unit associated with the viewed television set.

Some of the methods known in the art employ special identification codes, which are embedded in the broadcast signal at a broadcasting center. The broadcasted signal is detected by a monitor, which is connected to the television set of a selected viewer. This monitor extracts the embedded identification code, thereby determining the currently viewed channel, and provides an indication to a monitoring center. The monitoring center accumulates information from a plurality of such monitors and stores them in a database. The content of this database can then be used to statistically analyze viewing habits of a population.

US Patent No. 5,235,414 to Cohen is directed to a system for unobtrusively monitoring the viewing habits of an audience to home entertainment systems, equipped with digital remote controls. This system ensures that any remote control transmission is passed there

through before being provided to the destination device, which may be a television set, a stereo system, and the like. The monitor of the system conveys the detected remote control signal to various components of the home entertainment system, and is thus equipped to acquire and store  
5 audio/video tuning and channel selection data, for later transmission to a central computer.

US patent No. 4,972,503 to Zurlinden, is directed to a system for determining television audience viewing habits, wherein the viewer tuning information is acquired from infrared, ultrasonic, or other control signals  
10 transmitted by a user through a television remote control. This system employs a channel detection apparatus which receives and processes the emitted tuning data, to determine the selected television channel. During this processing, the detection apparatus temporarily jams the remotely controlled receiver from responding to the emitted control signal. Once  
15 the given processing is substantially completed, the detection apparatus ceases the jamming, to permit the remotely controlled receiver to respond accordingly.

The channel detection apparatus periodically rebroadcasts a control signal to the controlled receiver, instructing that receiver to tune  
20 the television to the last recorded channel.

US patent No. 4,876,736 to Kiewit, is directed to a system for determining the channel to which a television receiver is tuned, by evaluating the signal emitted by that receiver's remote controller. The system employs a first remote control transmitter which is specially  
25 designed to facilitate the process of channel selection determination, that is effected before the selection-making control signal is passed on to the receiver. The first remote control transmitter is initialized using the existing remote control transmitter for the receiver. However, the existing remote control transmitter is not thereafter used.

US patent No. 5,532,732 to Yuen et al., is directed to a system for television audience monitoring. According to Yuen, an audience monitor is coupled to a television from which it receives the tuned television channel signal via an input line. The audience monitor is  
5 actuated responsive to a television on/off signal, which it separately receives by one of two means -- through a line that passes the television's manual on/off switch, or through an infrared detector that receives the on/off command signal emitted by a remote controller. Upon command, the system detects a compressed identification which is embedded within  
10 the currently viewed channel. Then, the system transmits this identification to a remote location over a telephone line.

US patent No. 5,382,970 to Kiefl, is directed to a system for monitoring and recording the viewing habits of television viewers. The system employs a plurality of personal data meters, each of which is  
15 equipped with, among other things, a microprocessor, an infrared detector, a cellular phone and modem (also referenced as a telephone module). Each personal data meter is carried by a viewer, such that when the viewer views a television program, the personal data meter receives the program selection information transmitted via the given television's  
20 remote control, and then derives the corresponding channel and time information. At a pre-selected time, the personal data meter transmits stored information to a central location through its cellular telephone module. The personal data meter also includes a confirmation button by which the user confirms the channel number that the data meter is set to.  
25 However, this is a feature merely for confirming the user's actual attendance.

US patent No. 5,481,294 to Thomas et al., is directed to an audience measurement system for monitoring the viewing audience of television programs. The system includes a plurality of metering  
30 apparatuses distributed among statistically selected households. Each

metering apparatus includes tuning measurement equipment, having one or more sensors that acquire video and/or audio signals from a given television. The acquired signal(s) is processed in such a manner that program information is derived from any ancillary code, which may be present in the acquired signal. If no ancillary codes are present, the characteristic signatures are extracted from the acquired signals, and compared to reference signatures, so as to passively determine the given program information. The resulting information is transmitted with other pertinent data, through a telecommunications link to a central site. Each household metering apparatus, also includes a people meter which detects a signal transmitted by the given television's remote control. The stated purpose of the people meter, however, is merely to confirm the presence of audience members.

US patent No. 4,697,209 to Kiewit, is directed to a system for identifying the programs being received by a television. Essentially, the system operates by extracting a signature from the given video signal upon detection of predetermined characteristics in that signal. The extracted signature and the times corresponding thereto, are stored and subsequently compared, in order to identify the received television program. The detection of which channel/program is being viewed, is accomplished by using an embedded signature within the broadcast signal.

## SUMMARY OF THE PRESENT INVENTION

It is an object of the present invention to provide a novel method for monitoring television-viewing habits, which overcomes the disadvantages of the prior art.

5 It is another object of the present invention to provide a novel device for monitoring television-viewing habits, which overcomes the disadvantages of the prior art.

In accordance with the present invention, there is thus provided a monitoring device, which includes a processor, a television remote control unit signal detector, connected to the processor, a signal-capturing unit, connected to the processor, and a communication interface, connected to the processor. The television remote control unit signal detector, provides detected television remote control unit signal, to the processor. The signal-capturing unit provides the detected television  
10 signal to the processor. The processor transmits data related to the detected television signal, and the detected television remote control unit signal to a remote-monitoring center, via the communication interface.

The television remote control unit signal detector can be an infra-red detector, a radio frequency detector, an ultrasound detector and  
20 the like. The signal capturing unit can be a microphone, a video camera, an audio interface, a video interface, a broadcast signal interface and the like.

The data can include objects such as a representation of the detected television signal, a representation of the detected television remote control unit signal, a time stamp, a digital signature determined  
25 from the detected television signal, channel identity information determined from the detected television remote control unit signal, and the like.

The device can further include a storage unit, connected to the processor, wherein the processor stores data in the storage unit for transmitting via the communication interface at a later time.

According to one aspect of the invention, the signal capturing unit can include a tuner. Accordingly, the processor determines a broadcast channel from the detected television remote control unit signal, and provides a command to the tuner to select the broadcast channel. The tuner captures a broadcast signal transmitted on the broadcast channel. Finally, the processor determines a digital signature from the broadcast signal, and transmits the digital signature via the communication interface.

According to another aspect of the invention, the device further includes a tuner, connected to the processor, and a comparator connected to the processor, the television interface and to the tuner. Accordingly, the processor determines a broadcast channel from the detected television remote control unit signal, and provides a command to the tuner to select the broadcast channel. The tuner captures a broadcast signal transmitted on the broadcast channel, and provides the broadcast signal to the comparator. The signal capturing unit provides the detected television signal to the comparator. Finally, the comparator compares respective properties of the detected television signal and the broadcast signal, and provides a match result to the processor for verifying that the determined broadcast channel corresponds to the detected television signal.

According to a further aspect of the invention, the signal capturing unit can detect a television video signal, and provide the detected television video signal to the processor. Hence, the processor detects a plurality of frames in the detected television video signal.

The device can further include a multi channel tuner, connected to the processor. In this case, the processor determines a plurality of



broadcast channels from the detected television remote control unit signal, and provides a command to the tuner to select the broadcast channels. The tuner captures a plurality of broadcast signals transmitted on the selected broadcast channels, and provides the broadcast signals to the processor. Finally, the processor compares between an image provided in  
5 each of the frames, and a selected one of the broadcast signals.

In accordance with another aspect of the present invention, there is thus provided a method for detecting user selection of a television channel. The method includes the steps of detecting a remote control  
10 device transmission, receiving a television signal from a television set, and processing the television signal, thereby generating a signature therefrom.

The method can further include the step of producing a record, which includes a plurality of data objects, wherein at least one of the data objects includes the signature, and at least another of the data objects  
15 includes a time stamp. The method can further include the step of transmitting the record to a remote control center.

The method can further include the step of comparing the signature with at least one of a plurality of reference signatures, thereby determining a compatible reference signature therefrom.

20 The method can further include the step of determining a stream corresponding with the compatible reference signature. The method can further include the step of transmitting information relating to the determined stream, to a remote monitoring center.

The method can further include the step of storing information  
25 relating to the determined stream. The method can further include the step of storing the signature.

The method can further include the steps of detecting a video signal from a specific channel, processing the video signal, thereby generating a channel signature therefrom, comparing the channel

signature with the signature, thereby verifying that the specific channel corresponds to the television signal.

The method can further include the step of selecting the specific channel according to the remote control device transmission. The method  
5 can further include the step of selecting a different channel, when the specific channel is not compatible with the television signal.

The method can further include the step of transmitting parameters relating to the specific channel, when the specific channel is compatible with the television signal.

10 The method can further include the steps of analyzing the television signal, thereby determining a plurality of frames, and retrieving a frame television signal from each of the frames.

In accordance with a further aspect of the invention, there is thus provided a method for detecting user selection of television channels.  
15 The method includes the steps of receiving a television signal from a television set, detecting a plurality of channel images within the television signal, and processing the television signal thereby generating a signature for each of the channel images.

The method can further include the steps of detecting a remote  
20 control device transmission, and analyzing the remote control device transmission, so as to extract multiple channel commands embedded therein, wherein the multiple channel commands are further used in the step of detecting the plurality of channel images.

The method can further include the step of producing a plurality  
25 of records. Each of these records includes a plurality of data objects. At least one of the data objects includes the signature, and at least another of the data objects includes a time stamp. The method can further include the step of transmitting the records to a remote control center.

The method can further include the step of comparing each of  
30 the signatures with at least one of a plurality of reference signatures,

thereby determining at least one compatible reference signature, therefrom.

The method can further include the step of determining a stream corresponding with the compatible reference signatures.

5           The method can further include the steps of transmitting information relating to the determined stream, to a remote monitoring center. The method can further include the step storing information relating to the determined stream. The method can further include the step of storing the signature.

10           The method can further include the steps of detecting video signals from a plurality of specific channels, processing the video signals thereby generating channel signatures therefrom, and comparing the channel signatures with the signature, thereby verifying that at least one of the specific channels corresponds to at least a portion of the television  
15   signal.

The method can further include the step of selecting the specific channels according to the remote control device transmission.

The method can further include the step of selecting a different channel when at least one of the specific channels is not compatible with  
20   at least a portion of the television signal.

The method can further include the step of transmitting parameters relating to the specific channel, when the specific channel is compatible with at least a portion of the television signal.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the drawings in which:

5            Fig. 1 is a schematic illustration of a television set, a broadcast center, a monitoring center and a device for monitoring a video signal, constructed operative in accordance with a preferred embodiment of the present invention;

10           Figure 2 is a schematic illustration of a method for operating the combination of device and monitoring center of Figure 1;

            Figure 3 is a schematic illustration of a television set, a broadcast center, a monitoring center, and a television monitoring device, constructed and operative in accordance with another preferred embodiment of the present invention;

15           Figure 4 is a schematic illustration of a method for operating monitoring device and monitoring center of Figure 3, operative in accordance with a further preferred embodiment of the present invention;

            Figure 5 is a schematic illustration of a device, constructed and operative in accordance with another preferred embodiment of the present  
20           invention;

            Figure 6 is a schematic illustration of a method for operating the device of Figure 5, operative in accordance with a further preferred embodiment of the present invention;

            Figures 7A and 7B are schematic illustrations of a television,  
25           which is adapted to provide multiple channel presentation;

            Figure 8 is a schematic illustration of a device for monitoring multiple channels, constructed and operative in accordance with another preferred embodiment of the present invention;

Figure 9 is a schematic illustration of a method for operating the monitoring device of Figure 8, operative in accordance with a further preferred embodiment of the present invention;

Figure 10 is an illustration of a television set and two capturing  
5 devices, constructed and operative in accordance with another preferred embodiment of the present invention;

Figure 11A is a schematic illustration of the view detected by one of the cameras of Figure 10; and

Figure 11B is a schematic illustration of the view detected by  
10 another one of the cameras of Figure 10.

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## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention overcomes the disadvantages of the prior art by combining stream monitoring with user action detection. In general, the present invention includes two main elements, one being a signature generation procedure and the other, a user operation detection procedure.

The signature generation procedure processes the raw video signal and generates a signature therefrom. This signature is then compared with the signature produced from a reference stream to determine a match there between. Such a signature generation procedure is described in detail in US patent No. 5,790,236 to Hershtik et al., entitled "Movie processing system", which is hereby incorporated by reference. In this reference, the term signature is replaced with the term frame-characterizing information.

The user operation detection procedure employs a plurality of novel procedures and devices to determine user actions. The two elements are combined throughout the present invention, in various degrees of integration and relationship. For example, the user operation detection procedure can be used to determine which reference stream should be used, as will be described in detail herein below. In the detailed description herein below, the term "remote control unit" can refer to "remote control device", and vice versa.

Reference is now made to Fig. 1, which is a schematic illustration of a television set, a broadcast center, a monitoring center and a device for monitoring a video signal, generally referenced 100, operative in accordance with a preferred embodiment of the present invention.

Device 100 includes a processor 104, a storage unit 106, a detector 102, a communication interface 108 and a microphone 110. The processor 104 is connected to storage unit 106, detector 102, communication interface 108 and to microphone 110.

Television set 130 receives commands from a user using a remote control unit 134. These commands can include change channel commands, open and shut down commands, attribute (volume, contrast brightness etc.) commands and the like. It is noted that the remote control unit 134 can transmit the user commands to the television set, via either  
5 wireless link such as infra-red (IR), radio frequency (RF) or ultra-sound (US). Detector 102 is adapted according to the type of wireless media used by the remote control. In the present example, remote control unit 134 utilizes IR transmission (generally referenced 136). Hence, detector  
10 102 of device 100, an IR detector.

Television set 130 is connected to a broadcast center 124 via a video link 126. It is noted that video link 126 can include a cable TV link, an antenna, a satellite link, and the like. The broadcast center 124 transmits a plurality of channels to the television 130. The user operates  
15 the remote control unit 134 so as to select which of the channels he wishes to see on the television 130. The television 130 includes a detector 132 for detecting the signal 136 of the remote control unit 134. The signal 136 includes a sequence of commands, according to the operations of the user. It is noted that the microphone 110 can be carried by the user, while  
20 wirelessly transmitting detected audio signals to the device.

Reference is further made to Figure 2, which is a schematic illustration of a method for operating the combination of device 100 and a monitoring center 120.

As stated above, the device 100 detects the signal 136 of the  
25 remote control unit 134, using the detector 102 (step 150). The detector 102 provides the detected signal to the processor 104, which in turn analyzes the signal, thereby determining the embedded commands.

At the same time, the microphone 110 detects sounds in the vicinity of the television set 130 (step 152). The assumption is that the

major part of these sounds is generated by the television set, according to the viewed channels received from the broadcast center 124.

The microphone 110 converts the detected sounds to an audio signal and provides it to the processor 104. The processor 104 processes  
5 the audio signal, thereby producing a respective digital signature therefrom (step 154). It is noted that a signature can be generated using analog techniques.

According to the present example, the processor generates a record, which includes a plurality of data objects of various types (step  
10 156). A first type of data object includes information relating to the remote control command which was detected last. A second type of data object is the digital signature, which was produced from the moment of detection of that remote control command currently detected. A third type of data object includes a time stamp, which can include time and date information,  
15 respective of the moment in which the respective remote control command was detected, as well as the time period which relates to processed audio signal. It is noted that such a record can either include some of the above data objects or all of them.

The processor 104 can store this record in storage unit 106. The  
20 processor 104 transmits the generated records to the monitoring center 120 (step 158). It is noted that this transmission can either be in real time or at predetermined time intervals, after accumulation of a number of records in the storage unit 106.

The monitoring center 120 includes a communication interface  
25 142, for communicating with the device 100, a communication interface 146, for communicating with the broadcast center 124, a processor 144, a comparator 140 and a storage unit 148. The communication interface 142 is connected to the comparator 140 and to the processor 144. The processor 144 is further connected to the storage unit 148, the comparator  
30 140, and to the communication interface 146.



The monitoring center 120 is connected to the device 100 via a communication link 122, and to the broadcast center 124, via a communication link 123. The broadcast center 124 provides the plurality of channels to the monitoring center 120, via the communication link 123.

5 It is noted that communication links 122 and 123 can be either wireless, as in the present example, or wired. The processor 144 of the monitoring center 120 processes the received channels and produces a respective reference signature for each of them. According to one aspect of the present invention, the comparator 140 compares the digital signature

10 received from device 100 with each of the reference signatures (step 160), and detects compatibility with a specified one thereof, thereby determining a match with this reference signature (step 162). When a match is detected, then the comparator determines the channel associated with the reference signature as the channel, which is viewed by the user on the

15 television set 130.

According to another aspect of the present invention, the communication interface 142 provides selected objects of each one of the records received from the device 100. The processor 144 uses these objects to select a specific channel, and provide a respective reference

20 signature to the comparator 140. The selection criteria can include references to the channel selected by the user according to the detected remote control user command, the time at which this command was detected, the time at which the record was created, the time at which the attached digital signature was generated by the device 100 and the like.

25 The comparator 140 then compares the received digital signature with the selected reference signatures.

When a match is detected, then comparator 140 provides a respective indication to the processor 144, which in turn stores this information in the storage unit 148. It is noted that the information stored

in storage unit 148 can be processed according to a plurality of analysis methods to determine viewing habits and the like.

Reference is now made to Figure 3, which is a schematic illustration of a television set, referenced 230, a broadcast center, referenced 252, a monitoring center referenced 250 and a television  
5 monitoring device generally referenced 200, constructed and operative in accordance with another preferred embodiment of the present invention. The television set 230 includes a video signal outlet 236, an audio outlet 234 and a remote control signal detector 232. It is noted that such audio  
10 outlet can be an RCA outlet, an earphone outlet and the like. A remote control unit 240 is associated with television set 230, and produces wireless signals, generally referenced 242, which represent specific orders received from a user.

Monitoring device 200 includes a detector 208, which is adapted  
15 to detect wireless transmissions 242, a processor 204, an audio interface 210, a video interface 212, a storage unit 206 and a communication interface 202. The processor 204 is connected to detector 208, audio interface 210, video interface 212, storage unit 206 and to communication interface 202. Device 200 demonstrates an aspect of the present  
20 invention, in which the signal representing the channel viewed on the television set 230 is detected directly from the television set via standard outlets thereof.

Audio interface 210 is further connected to audio outlet 234. Video interface 212 is further connected to video outlet 236.  
25 Communication interface 202 is further connected to the monitoring center 250. The broadcast center 252 is connected to the monitoring center 250 via a communication link 256, and to the television set 230, via a communication link 254. It is noted that communication links 254 and 256 can be either wire communication links or wireless communication links,  
30 as described herein above.

Reference is further made to Figure 4, which is a schematic illustration of a method for operating device 200, together with monitoring center 250, operative in accordance with a further preferred embodiment of the present invention.

5           In step 270, the device 200 detects a remote control device transmission. The remote control transmission is generally detected by detector 208, which converts the received transmission signal into digital data and provides it to the processor 204.

10           In step 272, the device 200 receives a signal from the television set. This signal is respective of the currently viewed channel. Video interface 212 detects a video signal, which is provided by television set 230. This video signal is respective of the currently viewed channel. It is noted that this video signal can include a video stream as well as an audio stream. The audio interface 210 detects an audio signal, which is provided  
15           from the audio outlet 234. The audio signal includes an audio stream.

          According to the present invention, the device 200 has to receive at least one stream of information, video or audio. Accordingly, the audio interface can be used when the television set does not include a video outlet, or when the television set video outlet does not provide an  
20           audio stream. In any case, when the television set 230 includes a video outlet, then the audio interface 210 is optional.

          The video interface 212 and the audio interface 210 provide the detected streams to the processor 204. The processor 204 processes each of these streams and produces a digital signature therefrom (step  
25           274). It is noted that the processor 204 can produce a video digital signature from the video stream, an audio digital signature from the audio stream, or a combined digital signature from both streams.

          According to one aspect of the invention, the storage unit 206 includes a plurality of reference signatures, which are respective of a  
30           plurality of reference streams. It is noted that the storage unit 206 does

not contain these reference streams, rather an indication of the association between each of them and a respective reference signature.

The processor 204 compares the digital signature with at least a selected group of the reference signatures and attempts to detect a match  
5 there between. This group of reference signatures can be selected according to a variety of selection criteria. The selection criteria can be the channel which is associated with the currently detected remote control command; the time at which the streams that generated the digital signature was received; the most likely to be matched reference  
10 signatures according to recent user habit statistics, and the like.

When the processor 204 detects that one of the reference signatures is compatible with the digital signature, it determines the reference stream, which is associated with the matched reference signature (step 278). Then, the processor 204 generates a record, which  
15 includes information relating to the respective reference stream, and a time stamp. Finally the processor 204 transmits this record to the monitoring center 250 (step 280).

According to another aspect of the invention, at this point the processor 204 may generate a record, which is similar to the record  
20 produced by processor 104 (Figure 1). This record may include data objects relating to the digital signature, the detected remote control commands, a time stamp and the like. The processor 204 can store this record in the storage unit 206. The processor 204 transmits the record, either online or at predetermined time intervals, to the monitoring center  
25 250. The monitoring center includes means for comparing the digital signature embedded in the record to a plurality of reference signatures (step 276) and means for determining the reference stream, which is associated with a reference signature, which was detected as compatible with the digital signature

Reference is now made to Figure 5, which is a schematic illustration of a device, generally referenced 300, constructed and operative in accordance with another preferred embodiment of the present invention. Figure 5 also includes schematic illustrations of a monitoring center, a broadcast center and a remotely controlled television set.

Device 300 includes a processor 302, a communication interface 304, a tuner 306, a comparator 308, a television interface 310, a remote control transmission detector 312 and a storage unit 314. Processor 302 is connected to communication interface 304, tuner 306, comparator 308, remote control transmission detector 312 and to storage unit 314. Comparator 308 is further connected to the television interface 310, and to the tuner 306.

A television set 330 is connected to a broadcast center 352. The broadcast center 352 is further connected to a monitoring center 350. The television set 330 includes a remote control unit 340, and a remote control detector 332 which is adapted to receive the remote control transmissions, generally referenced 344.

The detector 312 is adapted to detect the remote control transmissions 344, and to transfer digital representations of the user commands embedded therein, to the processor 302. The television interface 310 can include one or more units such as a video interface, for directly connecting to the television set 330, an audio interface for directly connecting to the television set 330, a microphone, for detecting sounds in the vicinity of the television set 330, a video camera pointed at the screen of the television set 330, and the like. Hence, the television interface 310 can be either physically connected to the television set 330, or wirelessly detecting signals which are produced therefrom.

It is noted that the methods, which are presented in Figures 2 and 4, are applicable for device 300. According to a further aspect of the invention, the device 300 can be used as a fast passive channel detection

device. Accordingly, the device 300 detects remote control transmissions, and extracts any channel change commands embedded therein, thereby determining a hypothesis of the channel selected by the user, operating the remote control unit. The processor 302 determines the channel  
 5 according to a preset association table, which is stored in the storage unit 314. The association table is determined according to the channel settings on the television set 330. Reference is now made to Table 1, which provides a combined presentation of the television set channel settings and the monitoring device association table.

Table 1

| Entry (Station) Number | Television Set Entry | Monitoring Device Entry |
|------------------------|----------------------|-------------------------|
| 1                      | Channel 21           | Channel 21              |
| 2                      | Channel 53           | Channel 53              |
| :                      |                      |                         |
| n                      | Channel k            | Channel k               |

10

The Entry Number column indicates the same entry in the television set 330 station table, and in the monitoring device 300 association table. Access to a specific entry is determined by the user, which operates the remote control device 340, to generate a respective  
 15 command. When the detector 332 of television set 330 detects this command, then the television set 330 accesses the appropriate station entry, retrieves the channel information stored therein and tunes to that channel. At the same time, the detector 312 of the monitoring device 300 detects the same remote control command, and provides this information  
 20 to the processor 302, which in turn can send it to the monitoring center 350.

It is noted that the user is free to change the channel settings on the television set 330. Hence, the channel settings of the television set 330 may not always be compatible with the association table of the

monitoring device 300. Reference is now made to Table 2, which provides a non compatible combined presentation of the television set channel settings and the monitoring device association table.

Table 2

| Entry (Station) Number | Television Set Entry | Monitoring Device Entry |
|------------------------|----------------------|-------------------------|
| 1                      | Channel 21           | Channel 21              |
| 2                      | Channel 68           | Channel 53              |
| :                      |                      |                         |
| N                      | Channel k            | Channel k               |

5 In the present example, the user programmed the second entry in the television set to include channel 68, while the settings of the second entry in the association table include channel 53. According to this aspect of the present invention, the device 300 includes a confirmation mechanism, which detects and corrects such mismatches.

10 Reference is now made to Figure 6, which is a schematic illustration of a method for operating the device 300 of Figure 5, operative in accordance with a further preferred embodiment of the present invention. The detector 312 detects the channel change command and provides this information to the processor 302. The processor 302  
 15 determines the entry associated with the detected command, accesses the association table and retrieves the channel associated with that entry. Then, the processor 302 provides a channel change command to the tuner 306 (step 360).

20 The tuner 306, being connected to the same broadcast source as the television set 330, tunes to the selected channel, receives a broadcast signal, and provides a representation of that broadcast signal to the comparator 308 (step 362). It is noted that the representation can include either a video signal or an audio signal, which are extracted from

the broadcast signal, a digital signature (step 366) produced therefrom and the like.

At the same time, the TV interface 310 detects a TV signal, which is produced by the television set 330 (step 364). As stated above, this signal can be detected in a plurality of methods such as detecting a video signal or an audio signal, which are received directly from the television set 330, detecting sounds in the vicinity of the television set 330, detecting a signal from a video camera pointed at the screen of the television set 330, and the like.

The television interface 310 provides a representation of the detected TV signal to the comparator 308. It is noted that the representation can include either a video signal or an audio signal, which is extracted from the TV signal (depending on the source), a digital signature (step 368) produced therefrom, and the like.

The comparator 308 compares components, which are derived from respective streams of the TV signal and the broadcast signal (step 370). For example, the comparator can compare a digital signature produced from the video stream of the broadcast signal, with a respective digital signature, which is produced from the video stream of the TV signal. Similarly, the comparator can compare a digital signature produced from the audio stream of the broadcast signal, with a respective digital signature, which is produced from the audio stream of the TV signal.

If the comparator 308 detects that the compared components are compatible, it provides this information to the processor 302. In turn, the processor 302 determines that the content of the respective entry in the association table is valid with respect to the respective entry in the channel settings of the television set 330. At this point, the processor 302 transmits the confirmed channel selection of the user, to the monitoring center 350 via the communication interface 304 (step 374).



If the comparator 308 detects that the compared components are not compatible with each other, then it provides this information to the processor 302. It is noted that such a non compatibility indicates that the selected entry in the association table is not valid (see for example, entry  
5 No. 2 in Table 2).

The processor 302 initiates a channel scanning procedure so as to determine the currently viewed channel. Accordingly, the processor 302 specifies another channel and provides a respective channel change command to the tuner 306 (repeating from step 362). When a channel is  
10 detected to be compatible with the currently viewed channel, the processor 302 updates the selected entry in the association table so as to include the detected channel. According to the example of Table 2, the second entry in the association table is set to include channel 68.

Some television sets are capable of presenting more than one  
15 channel at the same time. This function is called multiple channel presentation. Reference is now made to Figures 7A and 7B, which are schematic illustrations of a television, generally referenced 390, which is adapted to provide multiple channel presentation. With reference to Figure 7A, television set 390 presents the broadcast of a primary channel  
20 generally on the entire area of screen 394. In addition, a frame, generally referenced 392 is defined at a selected location on the screen 394, where the broadcast of a secondary channel is presented. This function is often called Picture in Picture (PIP). It is noted that such a setting enables the user to view other channels at a glance, without switching off the primary  
25 channel. On some television sets, the user may define the location and size of frame 392, anywhere on the screen 394.

With reference to Figure 7B, television set 390 presents a multiple display of channels. Accordingly, a plurality of frames, generally referenced 396<sub>A</sub>, 396<sub>B</sub>, 396<sub>C</sub>, 396<sub>N-1</sub> and 396<sub>N</sub>, are defined on screen 394.  
30 The television set 390 presents a plurality of channels, generally denoted

channel 1, channel 2 to channel 9. It is noted that the number of channels depends on the number of independent tuner modules within television set 390. Furthermore, any arrangement of frames can be displayed on screen 394 with respect to the specification of a selected television set.

5           According to a further aspect of the present invention, there is thus provided a device which can monitor a plurality of viewed channels on a television set which is capable of PIP presentation. Reference is now made to Figure 8, which is a schematic illustration of a device, generally referenced 400, for monitoring multiple channels, constructed and  
10       operative in accordance with another preferred embodiment of the present invention. Figure 8 further includes a schematic illustration of a television set 430, a remote control unit 440, a monitoring center 450 and a broadcast center 452.

          Device 400 includes a communication interface 402, a  
15       processor 404, a multi-channel tuner 408, a television interface 410 and a remote control transmission detector 406. The processor 404 is connected to communication interface 402, multi-channel tuner 408, television interface 410 and to remote control transmission detector 406.

          The television interface 410 is connected to a video outlet 436 of  
20       television set 430. It is noted that television interface 410 can be replaced with a video camera which detects the entire image produced by the screen of television set 430. Television set 430 is connected to the broadcast center 452 through a broadcast inlet 438, via a communication link 454, which is also connected to multi-channel tuner 408.

25           Processor 404 is a multi-tasking processor which is operative to run a plurality of processes at the same time. The multi-channel tuner 408 includes a plurality of tuning modules (not shown) each being capable of tuning to a different channel. Hence the multi-channel tuner 408 provides a plurality of output channels at the same time. Device 400 is adapted to  
30       detect a multi-channel situation, determine the number and identity of

each of the displayed channels, and transmit this information to a remote monitoring center (reference 450).

Reference is further made to Figure 9, which is a schematic illustration of a method for operating monitoring device 400 of Figure 8, operative in accordance with a further preferred embodiment of the present invention.

The detector 406 detects a remote control transmission 442, generated at the remote control unit 440, which includes a multi-channel display command (step 470). The detector 406 provides the detected command to the processor 404. The processor 404 analyzes the detected remote control command, thereby determining the number of channels which the user requested to be displayed, and a hypothesis for the identification of each of the channels (step 472). The processor 404 produces a channel tuning command according to each of the hypotheses, and provides these channel tuning commands to the multi-channel tuner 408. The multi-channel tuner 408 assigns an independent tuning module to each of the channel tuning commands, thereby providing a plurality of channel signals to the processor 404. The processor 404 processes each of the tuned channel signals (multiple channel analysis process module 416), thereby producing a digital signature, one for each of the channel signals (step 480).

At the same time, the monitoring device 400 receives a TV signal from the television set 430 via the TV interface 410 (step 474) and provides the TV signal to the processor 404. The processor 404 analyzes the TV signal (multiple frame detection process module 412) thereby determining the location of the frame, which presents each of the displayed channels (step 478) and produces a signature from each of the frames (step 482). It is noted that in a PIP case, the entire screen defines the frame of the primary channel (see Figure 7A). The processor 404 initiates a comparison process (comparison process (1) module 414, and

comparison process (2) module 414<sub>N</sub>) for each pair, which includes a TV displayed channel and a tuned channel. Each of these modules 414<sub>1</sub> and 414<sub>N</sub> performs a verification of the displayed channel with the respective tuned in channel (step 484), so as to confirm the hypothesis produced in  
5 step 472. When the hypothesis is confirmed, the processor 404 transmits the channel identification information to the remote monitoring center 450, via the communication interface 402 (step 488). Otherwise, the processor specifies another channel (step 486) and repeats from step 476.

In accordance with a further aspect of the invention, a video  
10 capturing device is firmly attached to the monitored television set 430. According to this aspect, the capturing of the video image produced by the television set 430 is not affected by any position or orientation adjustment thereof.

Reference is now made to Figure 10, which is an illustration of a  
15 television set and two capturing devices, generally referenced 500 and 510, constructed and operative in accordance with a further preferred embodiment of the invention.

Capturing devices 500 and 510 are video cameras, which are mounted on specially designed devices. Camera 500 is mounted on an  
20 arm 502, which is attached to the television set 520 via a base 504. It is noted that the base 504 can be attached to the body of the television set 520, in a plurality of ways such as by means of adhesive materials, screws, and the like.

The arm 502 places the camera 500 on top of the television set  
25 520, facing down. Hence, the camera 500 is not located within the line of sight of a potential viewer.

Reference is further made to Figure 11A, which is a schematic illustration of the view detected by the camera 500 (Figure 10). As can be seen, the detected picture is deformed in the form of an upside trapezoid.  
30 Upper corners 522 and 524 of the screen (Figure 10) form the wider base

of the trapezoid (corners 522A and 524A), while lower corners 526 and 528 of the screen (Figure 10) form the narrower base of the trapezoid (corners 526A and 528A).

In accordance with the present invention, the detected image is  
5 reconstructed so as to obtain the original proportions of the screen of the television set 520, by allocating each pixel in the detected picture to a normalized matrix. After this step of reconstruction, any of the image processing procedures can be executed on the reconstructed image, such as signature generation, multi-picture detection and the like.

10 With reference to Figure 10, camera 510 is mounted on the side of television set 520, on an arm 512 and a base 514. Reference is further made to Figure 11B, which is a schematic illustration of the view detected by the camera 510 (Figure 10). As can be seen, the detected picture is deformed in the form of a side-rotated trapezoid. The left corners 522 and  
15 526 of the screen (Figure 10) form the wider base of the trapezoid (corners 522B and 526B), while the right-sided corners 524 and 528 of the screen (Figure 10), form the narrower base of the trapezoid (corners 524B and 528B).

It is noted that in this case, the correction procedure is very  
20 similar to the one shown in conjunction with Figure 11A, where the image is normalized side-ways.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described herein above. Rather the scope of the present invention is  
25 defined only by the claims which follow.

## CLAIMS

1. Monitoring device comprising:
  - a processor;
  - a television remote control unit signal detector, connected to said
  - 5 processor;
  - a signal capturing unit, connected to said processor; and
  - a communication interface, connected to said processor,
  - wherein said television remote control unit signal detector provides a
  - detected television remote control unit signal to said processor,
  - 10 said signal capturing unit provides a detected television signal to
  - said processor, and
  - wherein said processor transmits data related to said detected
  - television signal and said detected television remote control unit
  - signal to a remote monitoring center, via said communication
  - 15 interface.
2. The device according to claim 1, wherein said television remote control unit signal detector is selected from the list consisting of:
  - an infra-red detector;
  - 20 a radio frequency detector; and
  - an ultrasound detector.
3. The device according to claim 1, wherein said signal capturing unit is selected from the list consisting of:
  - 25 a microphone;
  - a video camera;
  - an audio interface;
  - a video interface; and
  - a broadcast signal interface.

30

4. The device according to claim 1, wherein said data includes objects selected from the list consisting of:
- a representation of said detected television signal;
  - a representation of said detected television remote control unit signal;
  - a time stamp;
  - a digital signature determined from said detected television signal; and
  - channel identity information determined from said detected television remote control unit signal.
- 5.
5. The device according to claim 1, further comprising a storage unit connected to said processor, wherein said processor stores data in said storage unit for transmitting via said communication interface at a later time.
- 15
6. The device according to claim 1, wherein said signal capturing unit comprises a tuner,
- wherein said processor determines a broadcast channel from said detected television remote control unit signal and provides a command to said tuner to select said broadcast channel,
  - wherein said tuner captures a broadcast signal transmitted on said broadcast channel, and
  - wherein said processor determines a digital signature from said broadcast signal and transmits said digital signature via said communication interface.
- 20
- 25
7. The device according to claim 1, further comprising a tuner, connected to said processor, and a comparator connected to said processor, said television interface and to said tuner,
- 30

wherein said processor determines a broadcast channel from said  
detected television remote control unit signal, and provides a  
command to said tuner to select said broadcast channel,  
wherein said tuner captures a broadcast signal transmitted on said  
5 broadcast channel, and provides said broadcast signal to said  
comparator,  
wherein said signal capturing unit provides said detected television  
signal to said comparator,  
wherein said comparator compares respective properties of said  
10 detected television signal and said broadcast signal and  
provides a match result to said processor for verifying that said  
determined broadcast channel corresponds to said detected  
television signal.

15 8. The device according to claim 1, wherein said signal capturing unit  
detects television video signal and provides said detected television  
video signal to said processor,  
wherein said processor detects a plurality of frames in said  
detected television video signal.

20 9. The device according to claim 8, further comprising a multi channel  
tuner, connected to said processor,  
wherein said processor determines a plurality of broadcast  
channels from said detected television remote control unit signal  
and provides a command to said tuner to select said broadcast  
25 channels,  
wherein said tuner captures a plurality of broadcast signals  
transmitted on said selected broadcast channels, and provides  
said broadcast signals to said processor, and



wherein said processor compares between an image provided in each of said frames and a selected one of said broadcast signals.

- 5 10. Method for detecting user selection of television channel comprising the steps of:
- detecting a remote control device transmission;
  - receiving a television signal from a television set; and
  - processing said television signal thereby generating a signature
- 10 therefrom.
11. The method according to claim 10, further comprising the step of producing a record including a plurality of data objects, wherein at least one of said data objects comprises said signature, and at least
- 15 another of said data objects comprises a time stamp.
12. The method according to claim 11, further comprising the step of transmitting said record to a remote control center.
- 20 13. The method according to claim 10, further comprising the step of comparing said signature with at least one of a plurality of reference signatures, thereby determining a compatible reference signature therefrom.
- 25 14. The method according to claim 13, further comprising the step of determining a stream corresponding with said compatible reference signature.

15. The method according to claim 14, further comprising the step of transmitting information relating to said determined stream, to a remote monitoring center.
- 5 16. The method according to claim 14, further comprising the step of storing information relating to said determined stream.
17. The method according to claim 10, further comprising the step of storing said signature.
- 10 18. The method according to claim 10, further comprising the steps of:  
detecting a video signal from a specific channel;  
processing said video signal thereby generating a channel signature therefrom; and  
15 comparing said channel signature with said signature, thereby verifying that said specific channel corresponds to said television signal.
19. The method according to claim 18, further comprising the step of  
20 selecting said specific channel according to said remote control device transmission.
20. The method according to claim 19, further comprising the step of selecting a different channel when said specific channel is not  
25 compatible with said television signal.
21. The method according to claim 19, further comprising the step of transmitting parameters relating to said specific channel, when said specific channel is compatible with said television signal.

22. The method according to claim 10, further comprising the steps of:  
analyzing said television signal thereby determining a plurality of  
frames; and  
retrieving a frame television signal from each said frames.

5

23. Method for detecting user selection of television channel comprising  
the steps of:  
receiving a television signal from a television set;  
detecting a plurality of channel images within said television  
signal; and  
processing said television signal thereby generating a signature  
for each said channel images.

10

24. The method according to claim 23, further comprising the steps of:  
detecting a remote control device transmission; and  
analyzing said remote control device transmission, so as to  
extract multiple channel commands embedded therein,  
wherein said multiple channel commands are further used in  
said step of detecting said plurality of channel images.

15

20

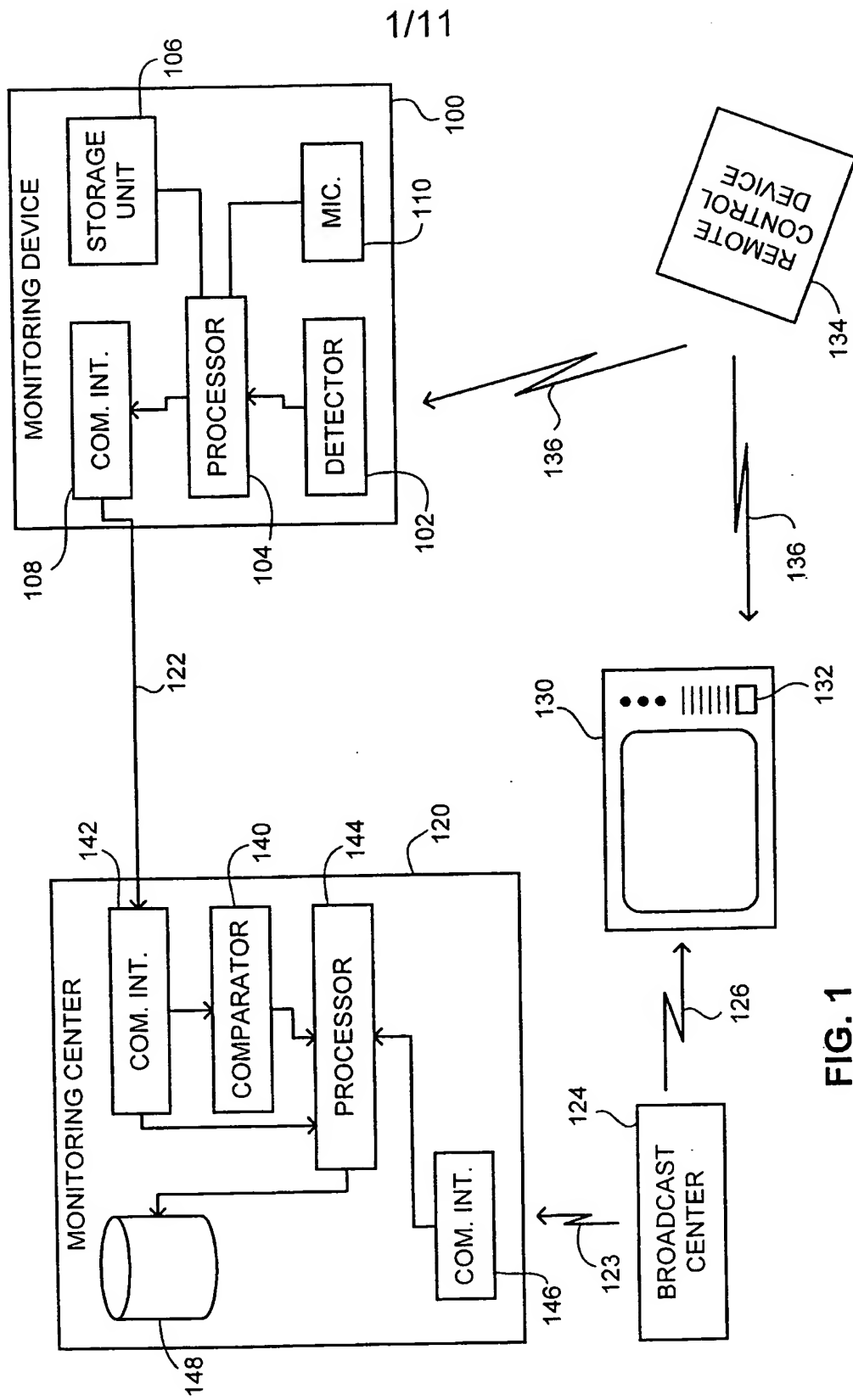
25. The method according to claim 23, further comprising the step of  
producing a plurality of records, each said records including a  
plurality of data objects, wherein at least one of said data objects  
comprises said signature, and at least another of said data objects  
comprises a time stamp.

25

26. The method according to claim 25, further comprising the step of  
transmitting said records to a remote control center.

27. The method according to claim 23, further comprising the step of comparing each said signatures with at least one of a plurality of reference signatures, thereby determining at least one compatible reference signature, therefrom.
- 5 28. The method according to claim 27, further comprising the step of determining a stream corresponding with said at least one compatible reference signature.
- 10 29. The method according to claim 28, further comprising the step of transmitting information relating to said determined stream, to a remote monitoring center.
- 15 30. The method according to claim 29, further comprising the step of storing information relating to said determined stream.
31. The method according to claim 23, further comprising the step of storing said signature.
- 20 32. The method according to claim 23, further comprising the steps of:  
detecting video signals from a plurality of specific channels;  
processing said video signals, thereby generating a channel signatures therefrom; and  
comparing said channel signatures with said signature, thereby  
25 verifying that at least one of said specific channels corresponds to at least a portion of said television signal.
- 30 33. The method according to claim 32, further comprising the step of selecting said specific channels according to said remote control device transmission.

- 5 34. The method according to claim 33, further comprising the step of selecting a different channel when said at least one of said specific channel is not compatible with at least a portion of said television signal.
- 10 35. The method according to claim 33, further comprising the step of transmitting parameters relating to said specific channel, when said specific channel is compatible with at least a portion of said television signal.
36. Monitoring device according to any of the claims 1-9 substantially as described herein above.
- 15 37. Monitoring device according to any of the claims 1-9 substantially as illustrated in any of the drawings.
38. A method according to any of the claims 10-22 substantially as described herein above
- 20 39. A method according to any of the claims 10-22 substantially as illustrated in any of the drawings.
40. A method according to any of the claims 23-35 substantially as described herein above.
- 25 41. A method according to any of the claims 23-35 substantially as illustrated in any of the drawings.
- 30



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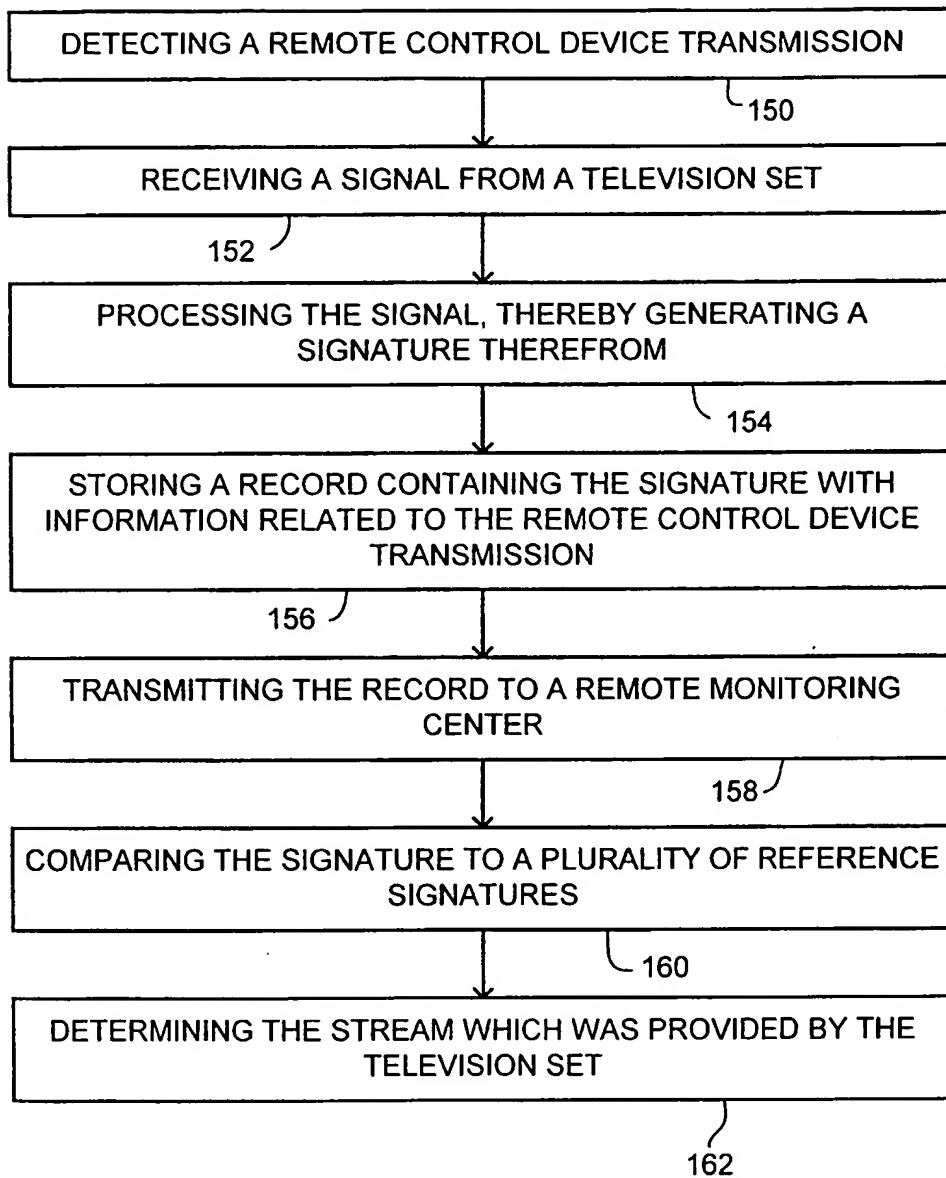


FIG. 2

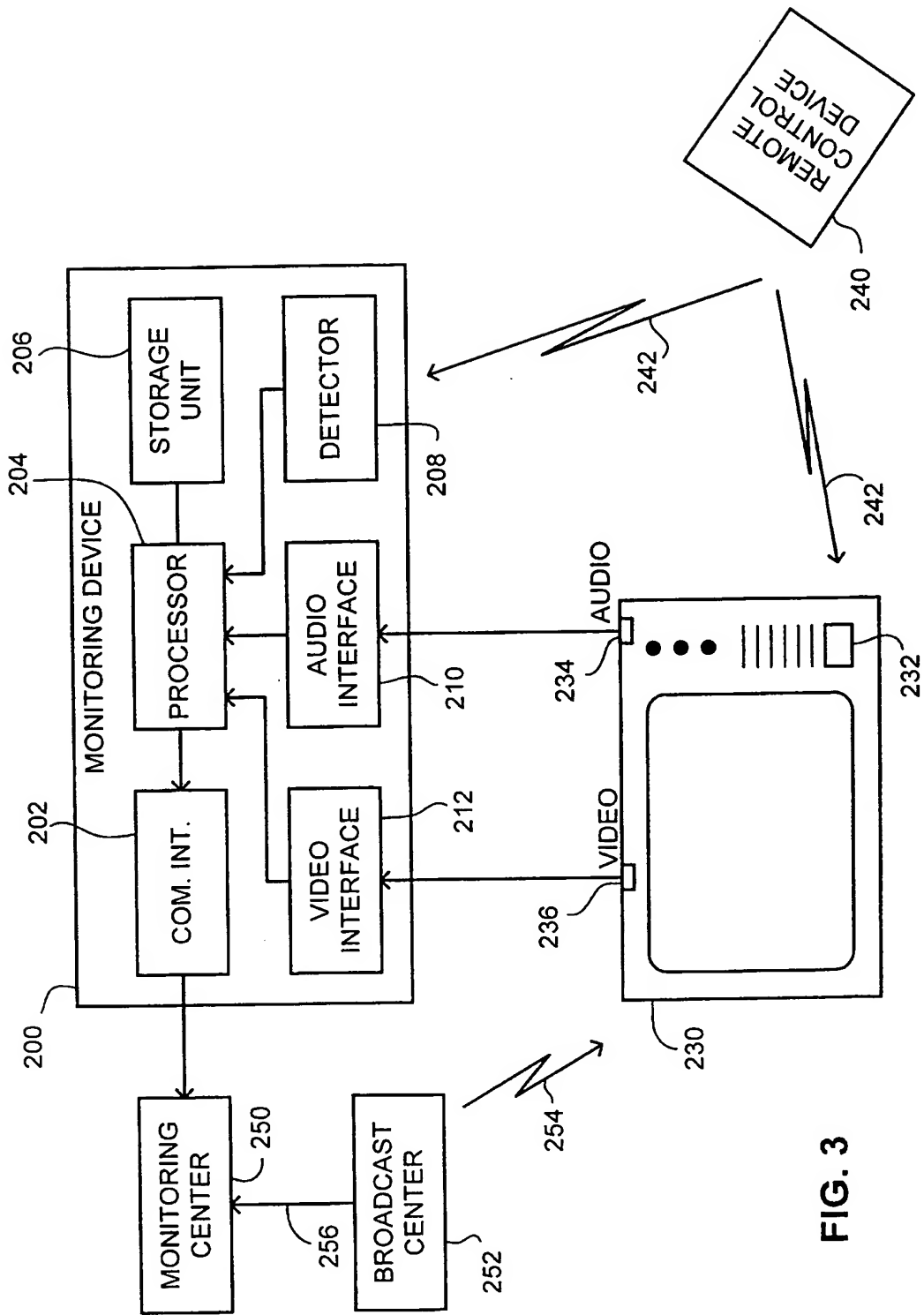


FIG. 3



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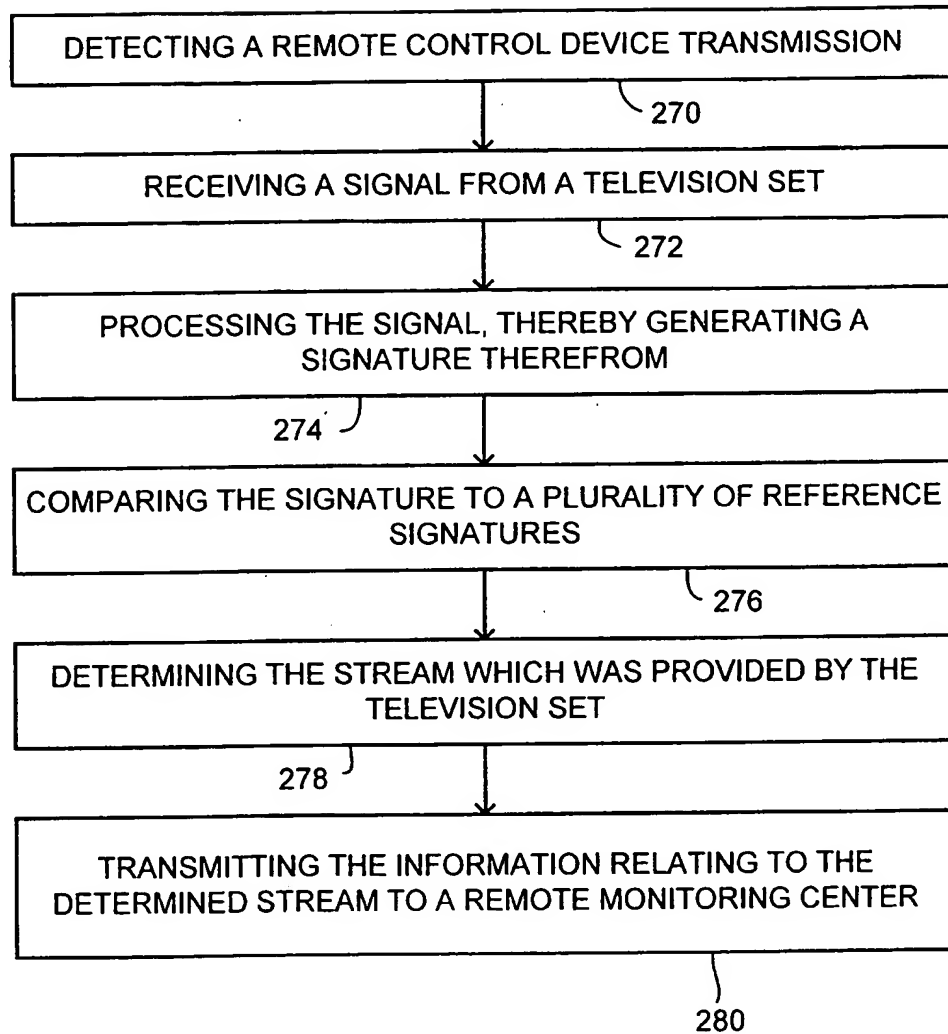
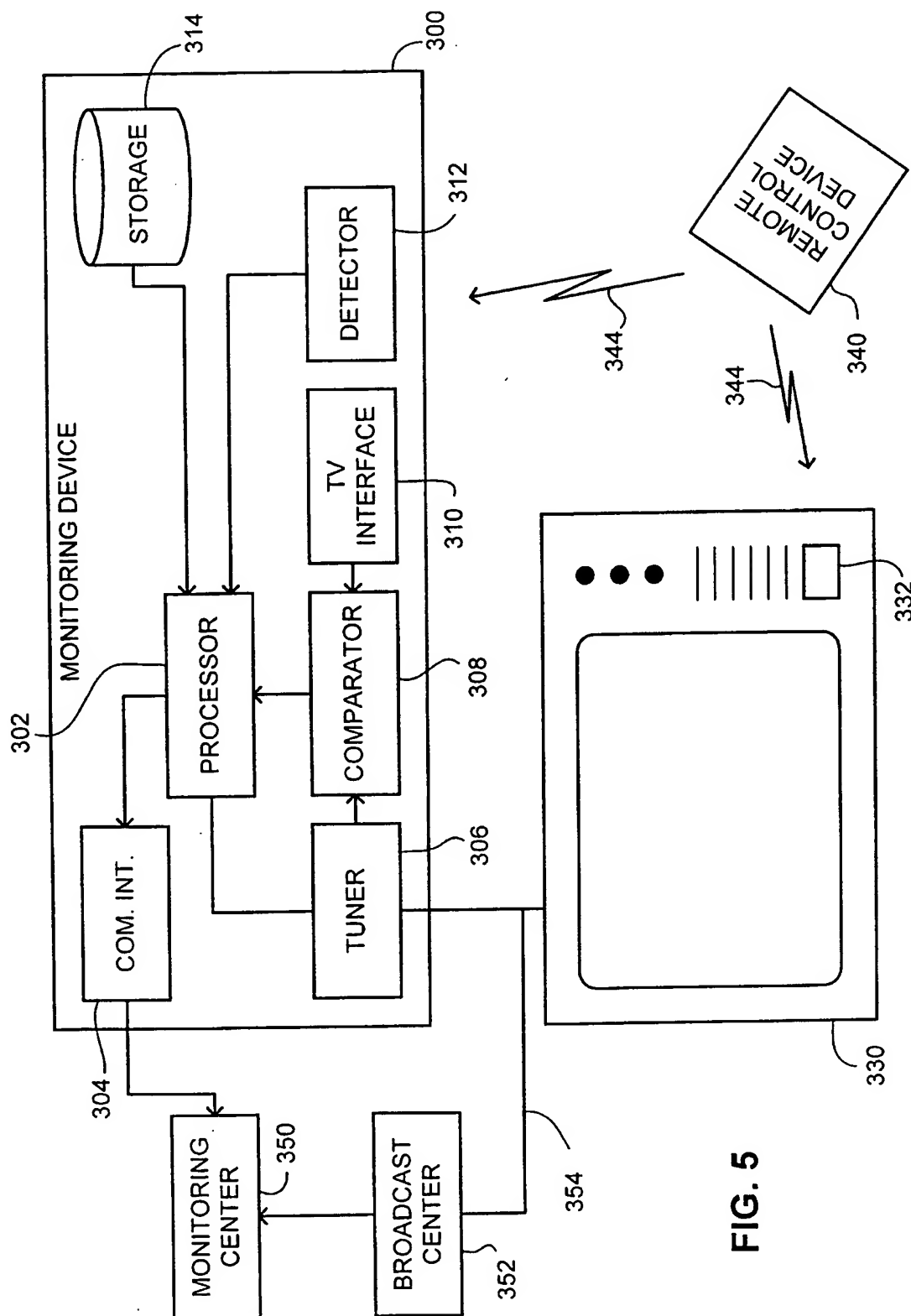


FIG. 4

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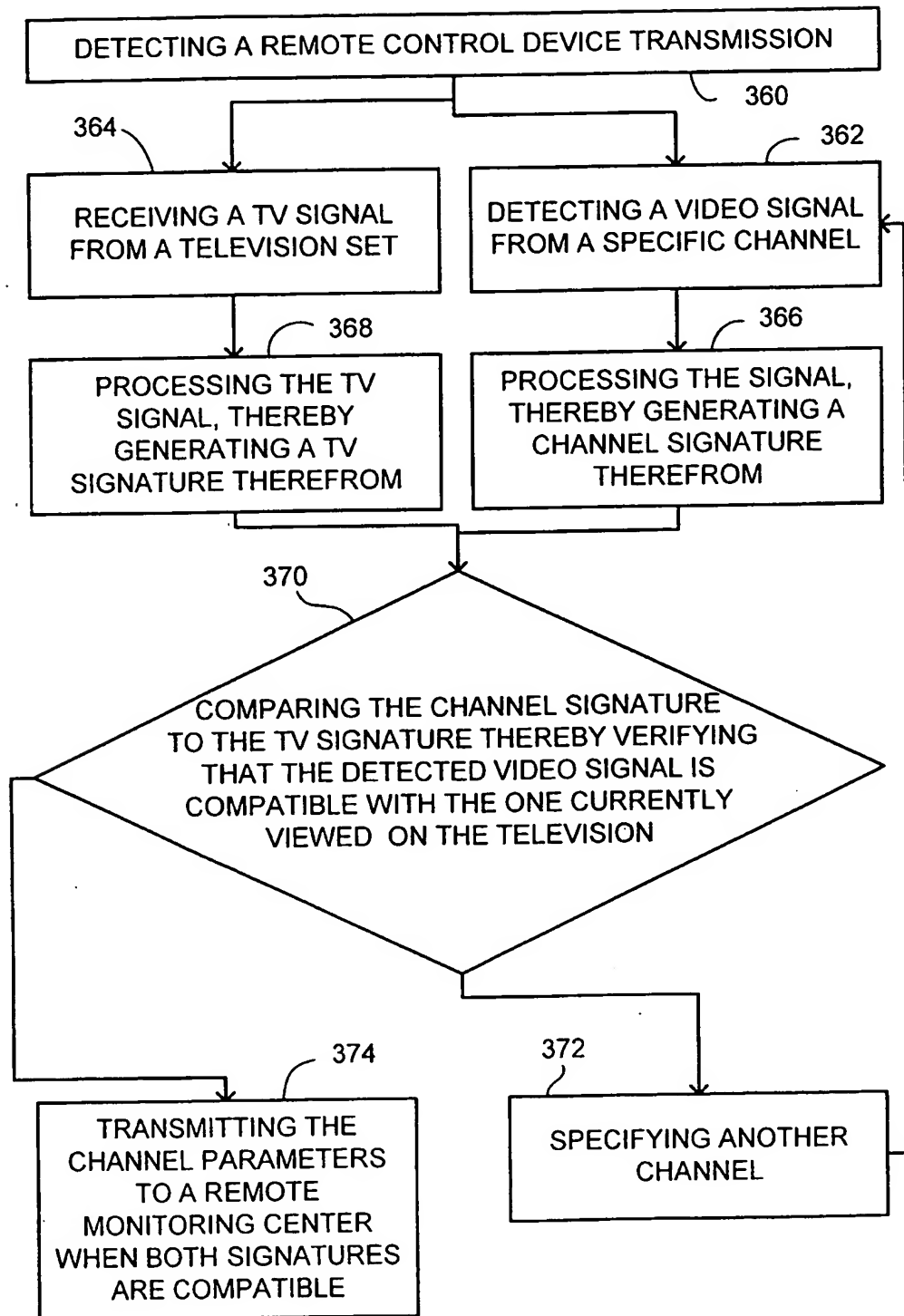
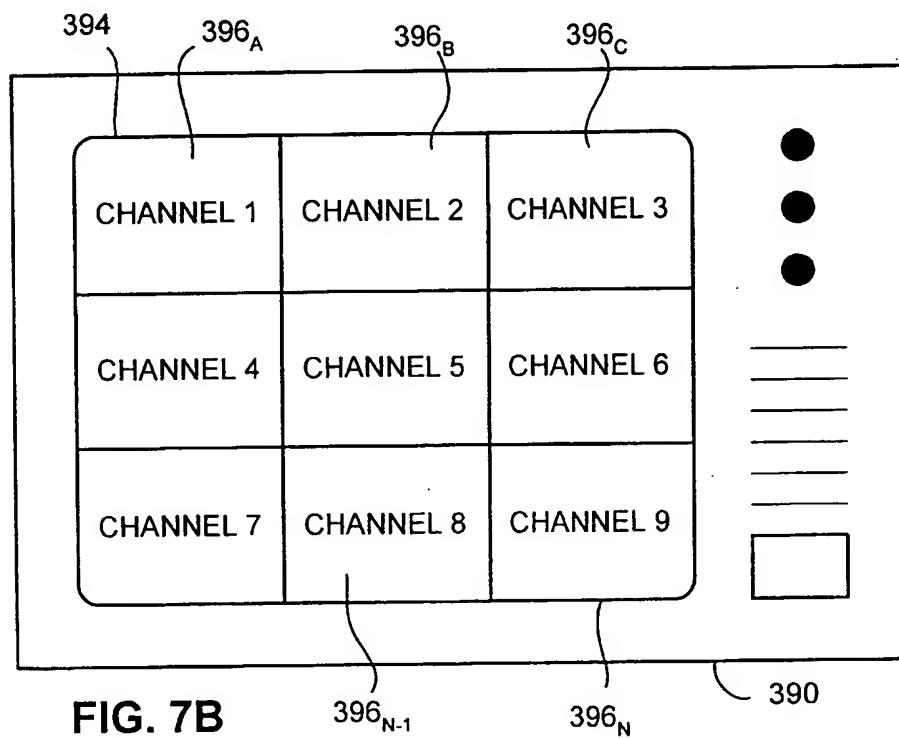
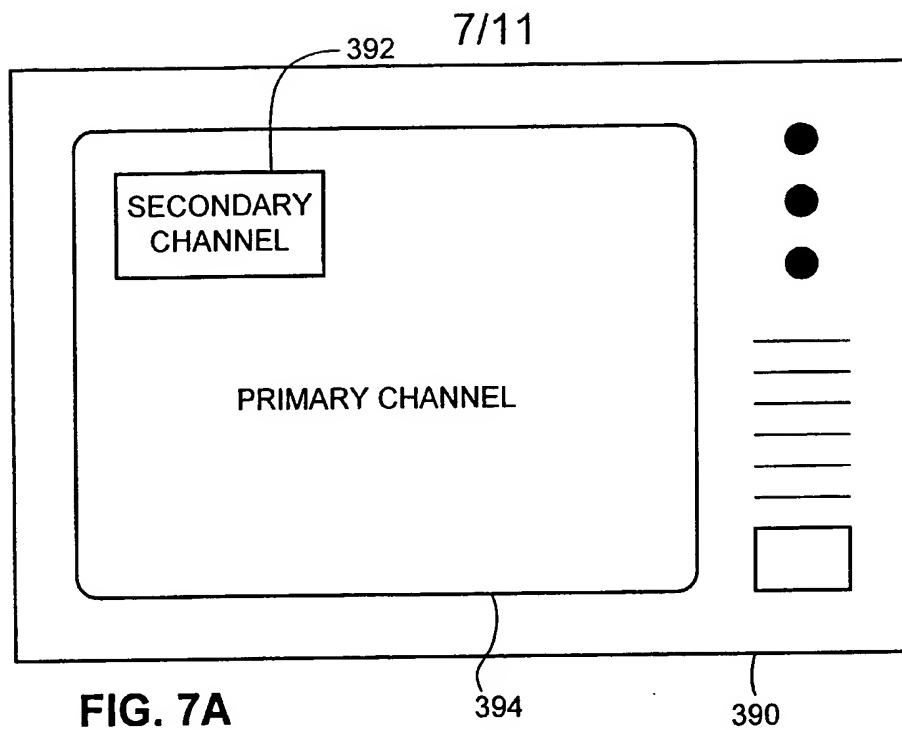


FIG. 6



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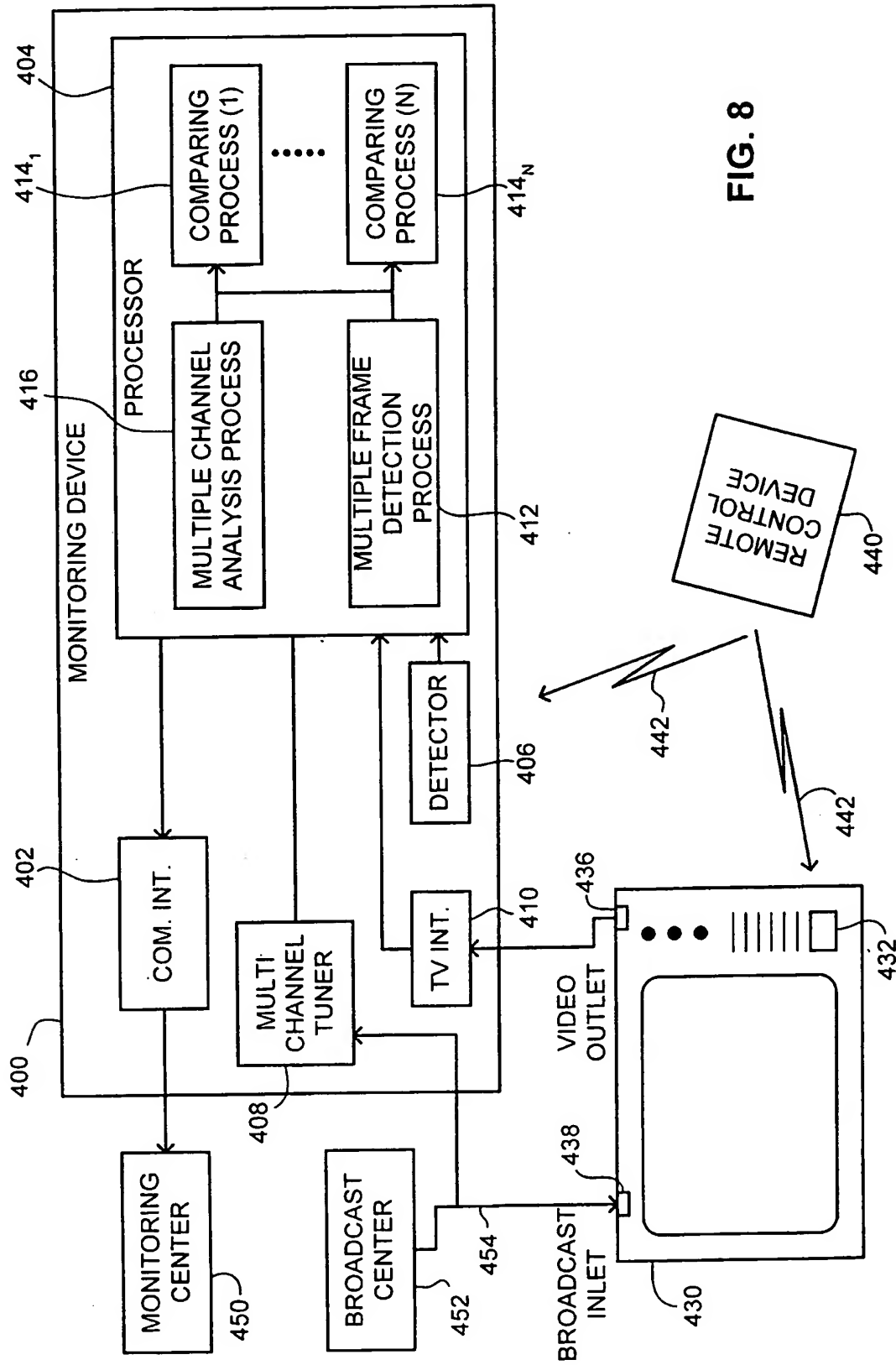


FIG. 8

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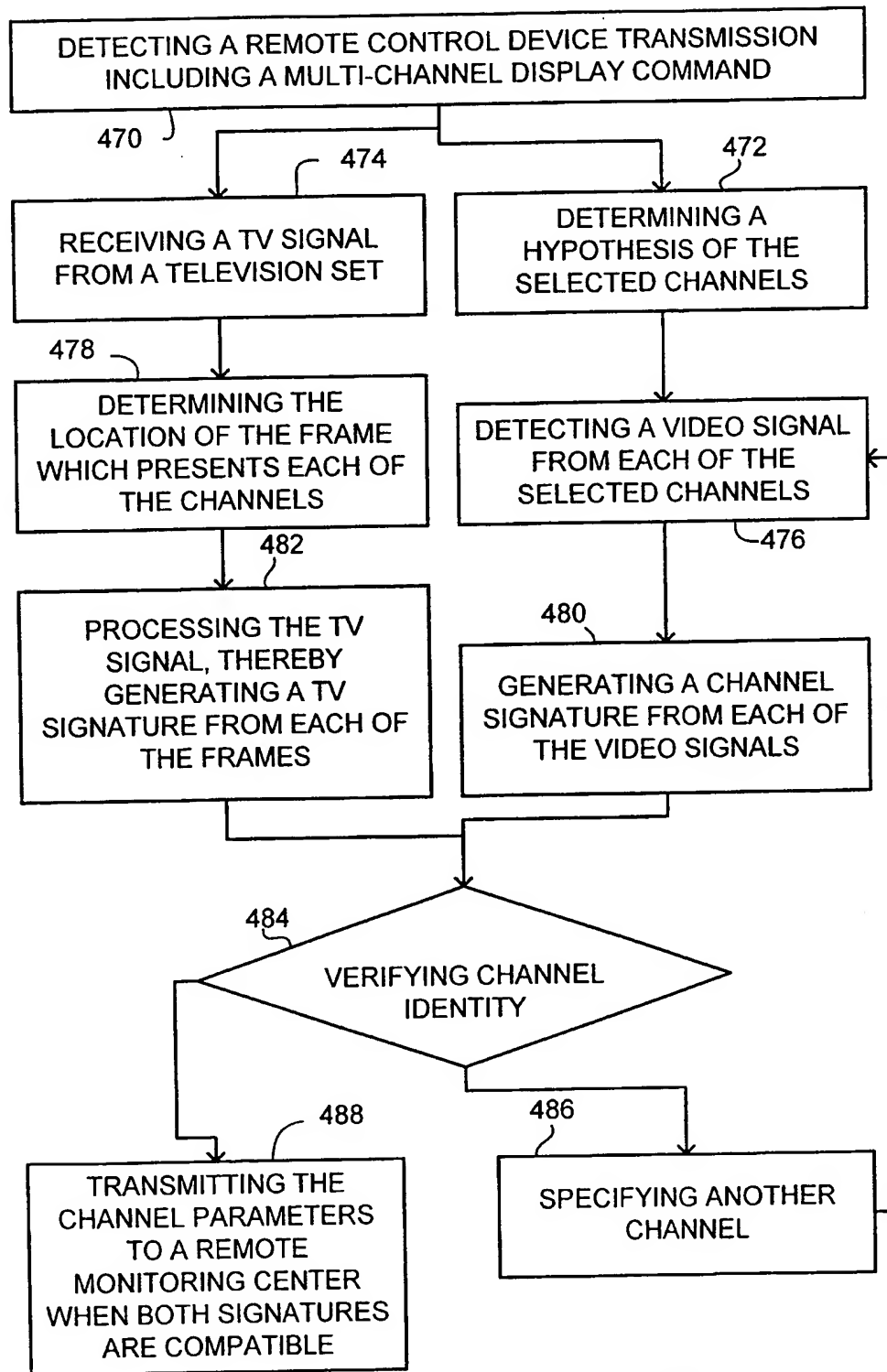


FIG. 9

10/11

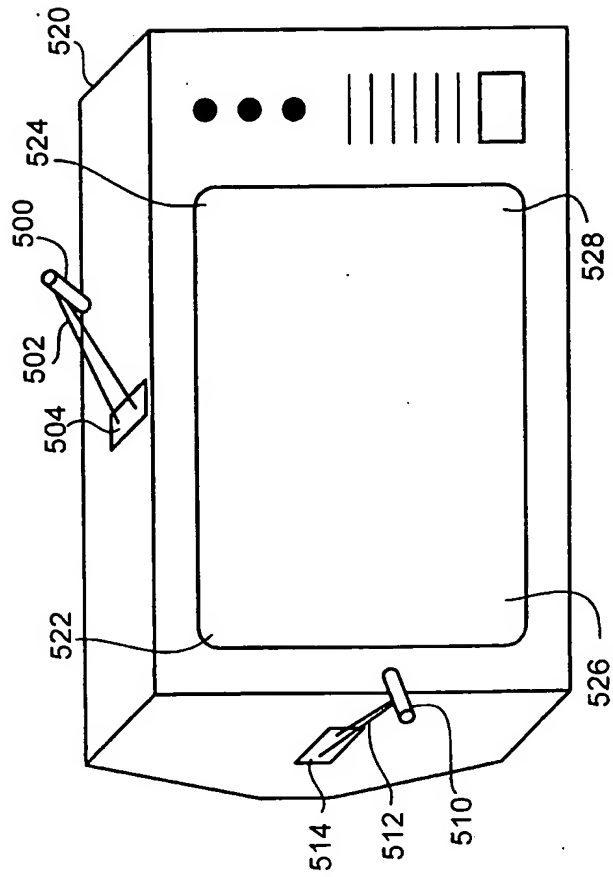
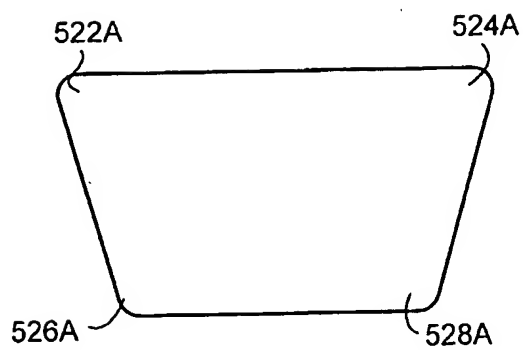
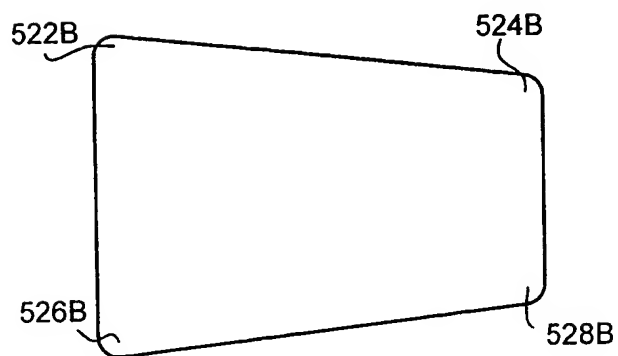


FIG. 10

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**FIG. 11A**



**FIG. 11B**



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IL00/00278

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>IPC(7) : H04N 7/00, 7/10; H04B 9/00, 17/00<br>US CL : 348/1; 455/2<br>According to International Patent Classification (IPC) or to both national classification and IPC   |  |   |
|---|--|---|
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>U.S. : 348/1; 455/2<br>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  |  |   |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>   |  |   |
| Category*   | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.   |
| X<br>----<br>Y  | US 5,798,785 A (HENDRICKS et al) 25 August 1998, col.7, lines 58-67, col.9, lines 49-60 col.10-11, col.12, lines 43-63, col.13-14, col.15, lines 50-55, col.18, lines 42-46, col.19, lines 47-67, col.21, col.22, col.24, lines 64-67 and col.24, lines 63-67.   | 1-5, 8, 10-22,<br>-----<br>6-7, 9 and 23-41   |
| Y   | US 5,374,951 A (WELSH) 20 December 1994, Fig.2, Col.4-6  | 6-7, 9, 36-37   |
| Y   | US 4,885,632 A (MABEY et al) 05 December 1989, fig.1, Col.10-13  | 23-35 and 38-41   |
| A   | US 5,532,732 A (YUEN et al) 02 July 1996   | 1-41  |
| A   | US 5,235,414 A (COHEN) 10 August 1993.   | 1-41  |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.  |  |   |
| * Special categories of cited documents:<br>*A* document defining the general state of the art which is not considered to be of particular relevance<br>*E* earlier document published on or after the international filing date<br>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br>*O* document referring to an oral disclosure, use, exhibition or other means<br>*P* document published prior to the international filing date but later than the priority date claimed | *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone<br>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art<br>*Z* document member of the same patent family |   |
| Date of the actual completion of the international search<br>18 SEPTEMBER 2000  |  | Date of mailing of the international search report<br>12 OCT 2000                           |
| Name and mailing address of the ISA/US<br>Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. (703) 305-3230   |  | Authorized officer<br>HAI VAN TRAN <i>James R. Matthews</i><br>Telephone No. (703) 308-0000 |

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IL00/00278

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| A         | US 5,278,988 A (DEJEAN et al) 11 January 1994                                      | 1-41                  |
| A         | US 5,758,257 A (HERZ et al) 26 May 1998  | 1-41                  |